66. A method as claimed in claim 65 wherein after oblique sputtering the free layer the free layer is annealed at a temperature from 150°C to 270°C in the presence of said field oriented parallel to said easy axis.

67. A method as claimed in claim 66 wherein for the free layer the angle β is 20° and the angle α is 40°.

68. A method as claimed in claim 67 wherein for the pinned and spacer layers angle α is 40° and angle β is 0°.

69. A method as claimed in claim 68 further including the steps of:

forming said antiferromagnetic (AFM) layer interfacing the pinned layer wherein the AFM layer includes a nickel oxide film and an α phase iron oxide film that interface one another; and

ion beam sputtering the nickel oxide film and the α phase iron oxide film at angles α and β wherein each angle α and β are acute and wherein the angles α and β are orthogonal with respect to one another.

70. A method as claimed in claim 69 wherein for the AFM layer the angle α is 40° and angle β is 10° - 30°.

REMARKS

Claims 1-27, 29, 30, 33, 45, 47 and 52 have been cancelled so that claims 32, 34, 36-42, 44, 46, 48, 49, 51, 53 and 55-70 remain in the application.

Claims 32 and 36-39 were rejected under 35 USC 103(a) as being unpatentable over Pinarbasi in view of Lin, Okuno and Tan. Claim 32 is distinguished over these references by reciting:

> "forming the free layer structure by obliquely ion beam sputtering at least one cobalt or cobalt based layer in the presence of a magnetic field oriented in a direction of said easy axis; and
>
> the oblique ion beam sputtering being at angles $\alpha = 40°$ and $\beta = 10° - 30°$, wherein angles α and β are orthogonal."

Oblique ion beam sputtering at angles α and β are discussed in detail in Applicant's Examples 2 and 3 which are compared with Example 1 where there is no angle β and Examples 5, 6 and 7 are compared with Example 4 where there is no angle β. Example 1 on pages 14 and 15 of Applicant's specification refer to a spin valve sensor 400 in Fig. 16. In regard to this spin valve sensor, Applicant's specification on page 15, lines 20-23, states:

> "All of the layers of the spin valve sensor 400 were formed by ion beam sputter deposition (IBSD) with sputtering angle $\alpha = 40°$ and sputtering angle $\beta = 0°$. Upon conducting tests on the spin valve sensor 400 it was found that the magnetoresistive coefficient dr/R of the spin valve sensor was 6.33%, . . . "

It will be seen from Applicant's Examples 2 and 3 that when β is greater than 0 the magnetoresistive coefficient dr/R of the spin valve sensor is improved. In Example 2 on page 16, lines 1-7 of Applicant's specification, it is stated:

> **"Example 2**
>
> Example 500, shown in Fig. 17, is the same as Example 400 shown in Fig. 16 except the layers 424, 422 and 426 of the free layer structure 406 were obliquely ion beam sputter deposited at a sputtering angle $\alpha = 40°$ and a sputtering angle $\beta = 20°$ while the remainder of the layers were ion beam sputter deposited at a sputtering angle $\alpha = 40°$ and sputtering angle $\beta = 0°$ of 90°. After conducting tests the magnetoresistive coefficient dr/R was 6.56%, . . . "

It can be seen from Example 2 that when the free layer structure 406 of the spin valve sensor is obliquely ion beam sputtered with $\alpha = 40°$ and $\beta = 20°$ that the magnetoresistive coefficient dr/R was increased from 6.33% to 6.56%. Further, page 16, lines 16-22 of the specification state:

> **"Example 3**
>
> Example 600, shown in Fig. 18, is the same as Example 500 shown in Fig. 17 except in addition to the free layer structure 406 being formed by oblique ion beam sputter deposition the spacer layer 402 is also formed by oblique ion beam sputter deposition with the same angles α and β. Upon conducting tests the magnetoresistive coefficient dr/R was 6.67%, . . . "

It can be seen from Example 3 that when the spacer layer 402, in addition to the free layer structure 406, is ion beam sputter deposited with oblique angles $\alpha = 40°$ and $\beta = 20°$ that the magnetoresistive coefficient dr/R was still further increased from 6.56% to 6.67%.

Another series of tests was conducted in Examples 4-7. In Example 4 a free layer structure 701 is located between bottom and top copper layers 702 and 704 and a capping layer 706 of tantalum is located on the copper layer 704. The entire structure 700 in Fig. 19 was ion beam sputter deposited with $\alpha = 40°$ and $\beta = 20°$. In regard to Example 4, page 17, lines 14-16 of the specification state:

> ". . . Fig. 20A shows easy axis and hard axis loops 720 and 722 in a M/H graph of Example 700 before annealing. The openness of the hard axis loop 722 shows considerable hysteresis when Example 700 is subjected to applied fields. . . . "

The large openness of the hard axis loop 722 in Fig. 20A is compared with Examples 5, 6 and 7 which incorporate Applicant's invention. In regard to Example 5, page 18, lines 1-5, state:

> **"Example 5**
>
> Example 800, shown in Fig. 21, is the same as Example 700, shown in Fig. 19, except the layers 710, 708 and 712 of the free layer structure have been obliquely ion beam sputter deposited at angles $\alpha = 40°$ and $\beta = 10°$. The easy axis and hard axis loops 820 and 822 for the Example 800 before annealing are shown in Fig. 22A. . . . "

It can be seen from Fig. 22A that the openness of the hard axis loop 822 is significantly less than the openness of the hard axis loop 722 in Fig. 20A when the angle β is increased to 10°. In regard to Example 6, page 18, lines 13-17 of the specification state:

> **"Example 6**
>
> Example 900, shown in Fig. 23, is the same as Example 800 shown in Fig. 21 except the layers 710, 708 and 712 of the free layer structure were obliquely ion beam sputtered at angles $\alpha = 40°$ and $\beta = 20°$. The easy axis and hard axis loops 920 and 922 before annealing are shown in Fig. 24A. . . ."

It can be seen that when angle β is increased to 20° the openness of the hard axis loop 922 in Fig. 24 is still further decreased. In regard to Example 7, page 18, lines 23-26 of the specification state:

> **"Example 7**
>
> Example 1000 in Fig. 25 is the same as the Example 900 in Fig. 23 except the layers 710, 708 and 712 of the free layer structure were obliquely ion beam sputtered at angles $\alpha = 40°$ and $\beta = 30°$. The easy axis and hard axis loops 1020 and 1022 before annealing are shown in Fig. 26A. . . . "

It can be seen from Example 7 that when the angle β is further increased to 30° that the openness of the hard axis loop 1022 in Fig. 26A is still further decreased. In regard to Examples 5, 6 and 7, the Applicant states, on page 19, from lines 5-7 of the specification, as follows:

> "From the above examples it can be seen that a sputtering angle β between 10° to 30° results in an improved free layer structure which employs a nickel iron (NiFe) layer between first and second cobalt (Co) layers. . . . "

In support of his rejection the Examiner states on page 9 of the Office Action:

> "Pinarbasi is discussed above and teach oblique ion beam sputtering of magnetic layers containing cobalt for magnetic sensors. A magnetic field can be used near the workpiece. (See Pinarbasi discussed above)"

In the discussion of Pinarbasi the Examiner states on page 6 of the Office Action as follows:

> ***"The primary ion source comprises a 12 cm Kaufman ion source adjustably mounted to provide a variable angle of incidence of the ion beam on the target 91 over a range of 0 degrees, i.e., normal to the target, to about 60 degrees.*** (Column 12 lines 46-49) ***Oblique sputtering occurs in the range of 0 to 60 degrees."***

Pinarbasi is referring to a single angle between his primary ion beam source 83 and his target 91 in contrast to orthogonal angles α and β between the target 91 and the substrate or workpiece 89. In this regard Pinarbasi states from column 11, line 61 to column 12, line 4 and lines 46-49 as follows:

> "Referring now also to FIG. 9, a detailed diagram illustrating a preferred embodiment of an ion beam sputtering system 80 according to the principles of the present invention is shown. The ion beam sputter deposition system 80 includes a vacuum chamber 81 in which a primary ion beam source 83 is mounted, a multi-target, rotatable support 85 having one or more targets 87 of selected materials mounted thereon and a deposition substrate 89. An ion beam provided by the ion source 83 is directed at a selected target 91 where the impacting ions cause sputtering of the target material. The sputtered ions emitted by the target material are directed onto a deposition substrate or other workpiece 89 on which is formed a layer of the selected target 91 material. . .
>
> . . . .
>
> The primary ion source comprises a 12 cm Kaufman ion source adjustably mounted to provide a variable angle of incidence of the ion beam on the target 91 over a range of 0 degrees, i.e., normal to the target, to about 60 degrees. . . . "

The Applicant maintains that Pinarbasi does not teach oblique sputtering with orthogonal angles α and β between the target 91 and the workpiece or substrate 89.

Still in further support of his rejection the Examiner states on page 9 of the Office Action:

> "The difference between Pinarbasi and the present claims is that a spin valve sensor is not discussed, orienting the magnetic field so that unaxial anistorpy is achieved along the easy axis is not discussed and the angles is not discussed."

In regard to Tan the Examiner states on pages 11 and 12 of his Office Action as follows:

> "Tan et al. teach oscillating the target and the substrate to achieve the ion beam sputtered angles. (Column 3 lines 49-53; Column 4 lines 65-68)
>
> The motivation for utilizing angles is that it allows for depositing films with uniformity in thickness. (Column 2 lines 52-56)
>
> Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Pinarbasi by forming a spin valve sensor as taught by Lin, by utilizing a magnetic field in the vicinity of the substrate and post annealed as taught by Okuno et al. and utilized angles as taught by Tan et al. because it allows for reading magnetic materials, providing uniaxial anisotropy and improving magnetic properties and for depositing films with uniformity in thickness."

The Applicant maintains that Tan does not teach oblique sputtering at angles α and β which are orthogonal with respect to one another, but in contrast teach angles α and β which are parallel with respect to one another. This is supported by column 4, line 62 to column 5, line 8 of Tan wherein it is stated:

> "It also should be noted that in contrast to the prior art sputtering mechanism illustrated in FIG. 1, there are no high voltage wirings or contacts affixed to either the target 36 or the substrate support 38. The target holder 36 can be designed with an oscillating motion signified by bidirectional arrow 42. In addition, the turntable 38A can be operated with rotating motions signified by arrow 59. Likewise, the substrate mounts 38C can be designed with rotatable motion signified by arrow 56 atop the turntable 38A. Optionally, the entire substrate support 38 can be operated in an oscillating motion as represented by bidirectional arrow 60. The motions 42, 56, 59 and 60 are all designed to achieve uniform film thickness on the substrate 50."

As can be seen from FIG. 2 of Tan the target 40 can be rotated along arc 42 about pivot 36D while the substrate 38 can be rotated along arc 60 about unnumbered pivot point near 38B. Both of the angles along arcs 42 and 60 are within the same plane and are not orthogonal as recited in claim 32. Further in regard to Tan in the Examiner's ***Response to Arguments*** on page 19 of the Office Action the Examiner states:

"In response to the argument that Tan does not teach angles orthogonal, it is argued that the combination of target movement and rotational angular movement of the substrate will achieve the desired angles. (See Tan et al. discussed above)"

The Applicant disagrees that oblique sputtering with angles α and β can be achieved from the Tan teaching. The target holder 36 in Fig. 2 of Tan rotates about a pivot 36D as shown by arrows 42 and the substrate 38 rotates about an unnumbered pivot about arrows 60. The arrows 42 and the arrows 60 are in the same plane and the rotations of either one or both of the target 36 and the substrate 38 does not result in oblique sputtering with angles α and β. It can be seen from Fig. 2 of Tan that the nominal planes of the target holder 36 and the substrate 38 are at a single acute angle with respect to one another. In order to achieve Applicant's teaching either the target holder 36 or the substrate 38 would have to be capable of rotating into the plane of the paper or out of the plane of the paper in order to achieve the double angles α and β which distinguish Applicant's invention from the prior art. It should be noted that the rotation of the turntable 38A about 38B to produce rotation 59 or the rotation of the substrate mounts 38C about axes 46 to produce rotations 56 singly or in combination do not produce the other angle β required by Applicant's teaching.

Claim 40 was rejected under 35 USC 103(a) as being unpatentable over Lin in view of Fujikata and Pinarbasi. Amended claim 40 is distinguished over these references by reciting:

"forming the pinning layer structure of a nickel oxide (NiO) layer and an alpha iron oxide (αFeO) layer wherein at least one of the nickel oxide (NiO) layer and the alpha iron oxide (αFeO) layer has been obliquely ion beam sputtered at angles α and β wherein angles α and β are orthogonal with respect to one another."

Claim 40 is considered to be patentable over the cited references for the same reasons as given in support for claim 32. In support of his rejection the Examiner states on page 12 of the Office Action:

"The difference not yet discussed is utilizing two layers for the pinning layer structure.

Fujikata et al. teach utilizing an antiferromagnetic thin film comprised of a two-layer structure composed of a CoO layer deposited on a NiO layer. (See Abstract) As the additional antiferromagnetic layer for stabilization of the magnetic domains, those materials such as FeMn, NiMn, NiO, CoO, Fe2O3, FeO, CrO, and MnO are preferred. (Column 6 lines 2-5)

The motivation for utilizing a two layer structure is that it allows for avoiding Barkhausen jumps. (Column 6 line 1)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized a two layer structure as taught by Fujikata et al. because it allows for avoiding Barkhausen jumps."

Applicant's claim 34 is clearly distinguished from Fujikata by reciting the alpha phase of iron oxide (αFeO) in contrast to ferric oxide (Fe_2O_3 or FeO) as taught by Fujikata. Claim 34 is still further distinguished over Fujikata by reciting the pinning layer structure as including two layers, namely a nickel oxide (NiO) layer and an alpha iron oxide (αFeO) layer. In contrast, Fujikata places his iron oxide layer next to his free layer instead of placing his iron oxide layer next to his pinning layer. In this regard, the Examiner's attention is respectfully invited to column 1, lines 30-37 and column 5, line 60 to column 6, line 11 of Fujikata wherein it is stated:

"Recently, proposal is made of a magnetoresistance effect film which comprises at least two ferromagnetic layers or thin films stacked one over the other with a nonmagnetic layer or thin film interposed therebetween, and an antiferromagnetic layer or thin film underlying a first one of the ferromagnetic thin films so that the first ferromagnetic thin film is provided with antimagnetic force, that is, constrained by exchange anisotropy or exchange biasing.

. . . .

In the above-mentioned magnetoresistance effect film, an additional antiferromagnetic layer or a permanent magnet layer may be arranged adjacent to the second ferromagnetic layer which is for detecting the external magnetic field so that a biasing magnetic direction by the permanent magnet or the additional antiferromagnetic layer is in the direction of the easy magnetization axis of the second ferromagnetic layer. With this structure, magnetic domains of the second ferromagnetic layer can be stabilized so that nonlinear outputs such as Barkhausen jumps can be avoided. As the additional antiferromagnetic layer for stabilization of the magnetic domains, those materials such as FeMn, NiMn, NiO, CoO, Fe_2O_3, FeO, CrO, and MnO are preferred. As the permanent magnet layer, those materials such as CoCr, CoCrTa, CoCrTaPt, CoCrPt, CoNiPt, CoNiCr, CoCrPtSi, and FeCoCr are preferred. Furthermore, Cr or the like may be used as a primer or an underlying layer for the permanent magnet layer."

In the first part of the quote Fujikata refers to a first ferromagnetic thin film which is pinned by a ferromagnetic layer and a second ferromagnetic layer wherein the first and second ferromagnetic layers are spaced apart by a nonmagnetic spacer layer. The latter part of the quote refers to placing a ferric oxide layer next to the second ferromagnetic layer which is the free layer, not the pinned

layer. Claim 34 recites the ferric oxide layer as being part of the pinning layer structure in contrast to being located next to the free layer as taught by Fujikata. The teaching that Fujikata provides is employment of the antiferromagnetic layers (or hard bias layers as known in the art) as seen in Figs. 1 and 2 of Fujikata for stabilizing the magnetic domains of the free layer 2.

Further, in the Examiner's ***Response to Arguments*** on page 20 of the Office Action he states:

> "In response to the argument that the references do not teach utilizing a nickel oxide and an alpha iron oxide layer as part of the pinning layer structure, it is argued that Fujikata et al. suggest utilizing a two layer structure of NiO and iron oxide as antiferromagnetic material which can be used in the pinned structure of Lin. (See Fujikata et al. and Lin discussed above)"

As stated above and as taught by Fujikata his alpha iron oxide layer is adjacent the free layer and not the nickel oxide (NiO) antiferromagnetic pinning layer. Accordingly, claim 34 is clearly distinguished over the references. Further, in support of his rejection, the Examiner states on page 13 of the Office Action:

> "Fujikata et al. teach depositing a dual layer NiO and FeO layer. (See Fujikata discussed above)
>
> The motivation for utilizing a dual layer NiO and FeO layer is that it allows for avoiding Barkhausen jumps. (See Fujikata discussed above)
>
> Pinarbasi is discussed above and teach oblique ion beam sputtering for oxides. (See Pinarbasi discussed above)
>
> The motivation for utilizing oblique ion beam sputtering is that it allows for minimizing the internal stresses in the deposited films. (Column 2 lines 27-30)
>
> Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Lin by utilizing a dual layer as taught by Fujikata and to have obliquely sputtered as taught by Pinarbasi because it allows for avoiding Barkhausen jumps and for minimizing internal stresses in deposited films."

As stated hereinabove, Fujikata does not use a dual layer of NiO and FeO, but in contrast employs FeO as antiferromagnetic layers 6 in Figs. 1 and 2 of Fujikata for stabilizing the magnetic domains in his free layer 2.

Claim 41 was rejected under 35 USC 102(a) as being unpatentable over Lin in view of Pinarbasi and Okuno. Amended claim 41 is distinguished over the references by reciting:

"the oblique ion beam sputtering being at angles $\alpha = 40°$ and $\beta = 10° - 30°$ wherein angles α and β are orthogonal; and"

In support of his rejection the Examiner states on pages 13 and 14 of the Office Action:

"The difference between Lin and the present claims is that oblique sputtering is not discussed.

Pinarbasi is discussed above and teach oblique sputtering. (See Pinarbasi discussed above)

The motivation for utilizing oblique ion bean sputtering is that it allows for minimizing the internal stress in the deposited films. (See Pinarbasi discussed above)"

As discussed hereinabove, Pinarbasi does not teach oblique ion beam sputtering with angles α and β.

Claim 42 was rejected under 35 USC 103(a) as being unpatentable over Lin in view of Pinarbasi and Okuno and further in view of Fujikata and claims 44 and 46 were rejected under 35 USC 103(a) as being unpatentable over Lin in view of Pinarbasi and further in view of Fujikata and Okuno and further in view of Tan. Claims 42, 44 and 46 are considered to be patentable over these references for the same reasons as given in support for claim 41.

Claims 55-59 were rejected under 35 USC 103(a) as being unpatentable over Pinarbasi in view of Tan. Claim 55 is distinguished over these references by reciting:

"the oblique ion beam sputtering being at angles α and β wherein each angle α and β is acute and wherein the angles α and β are orthogonal with respect to each other."

Claim 55 is considered to be patentable over these references for the same reasons as given in support for claim 32. Dependent claims 56-59 are considered to be patentable over the references for the same reasons as given in support for claim 55. Claims 56-58 are further distinguished over the references by reciting the specific angles α and β as taught by Applicant's specification and discussed hereinabove.

Claims 60, 61, 62, 63 and 64 were rejected under 35 USC 103(a) as being unpatentable over Pinarbasi in view of Tan and further in view of Fujikata. Claims 60, 61 and 62, which are dependent upon claims 59 and 55, are considered to be patentable over these references for the same reasons

as given in support for claim 55 and claims 61 and 62 are further distinguished over the references for the same reasons as given in support for claims 56, 57 and 58. Claim 63, which is dependent upon claim 55, is considered to be patentable over the references for the same reasons as given in support for claim 55 and claim 64 is further distinguished over the references by reciting angle β as being 10°-30°.

Claims 65-70 were rejected under 35 USC 103(a) as being unpatentable over Pinarbasi in view of Tan and further in view of Fujikata and further in view of Okuno. Claims 65-70, which are dependent upon claim 64, are considered to be patentable over the references for the same reasons as given in support for claim 64.

The Applicant has made minor amendments to the claims which either incorporate limitations from dependent claims or similar limitations from existing claims which amendments the Applicant respectfully requests that the Examiner enter. The Applicant also respectfully submits that the claims discussed hereinabove are patentable over the cited references.

Should the Examiner have any questions regarding this Amendment he is respectfully requested to contact the undersigned.

Respectfully submitted,

By: Ervin F. Johnston
Attorney for Applicant(s)
Registration No. 20,190
Telephone: 619-334-5883
Fax: 619-448-1904

ATTACHMENT

In the specification

Page 18, line 23, delete "24" and substitute therefor --23-- .

In the claims:

Cancel claims 1-27, 29, 30, 33, 45, 47 and 52.

Amend claims 34, 40, 41, 46, 48 and 63.

34. (Twice Amended) A method of making a magnetic read head, which includes a spin valve sensor, comprising the steps of:

a making of the spin valve sensor comprising the steps of:

forming a free layer structure that has a magnetic moment and an easy axis;

forming a ferromagnetic pinned layer structure that has a magnetic moment;

forming a pinning layer exchange coupled to the pinned layer structure for pinning the magnetic moment of the pinned layer structure;

forming a nonmagnetic conductive spacer layer between the free layer structure and the pinned layer structure;

forming the free layer structure by obliquely ion beam sputtering at least one cobalt or cobalt based layer in the presence of a magnetic field oriented in a direction of said easy axis;

the pinning layer structure being formed by forming a nickel oxide (NiO) layer and an alpha iron oxide (α FeO) layer wherein each of the nickel oxide (NiO) layer and the alpha iron oxide (α FeO) layer has been formed by oblique ion beam sputtering[.] at angles α and β wherein angles α and β are orthogonal with respect to one another.

40. (Once Amended) A method of making a magnetic read head, which includes a spin valve sensor, comprising the steps of:

forming the spin valve sensor as follows:

forming a ferromagnetic pinned layer structure that has a magnetic moment;

forming a pinning layer exchange coupled to the pinned layer structure for pinning the magnetic moment of the pinned layer structure;

forming a nonmagnetic conductive spacer layer between the free layer structure and the pinned layer structure; and

forming the pinning layer structure of a nickel oxide (NiO) layer and an alpha iron oxide (αFeO) layer wherein at least one of the nickel oxide (NiO) layer and the alpha iron oxide (αFeO) layer has been obliquely ion beam sputtered[.] at angles α and β wherein angles α and β are orthogonal with respect to one another.

41. (Twice Amended) A method of making a magnetic read head, which includes a spin valve sensor, comprising:

a making of the spin valve sensor including the steps of:

forming a free layer structure that has a magnetic moment and an easy axis;

forming a ferromagnetic pinned layer structure that has a magnetic moment;

forming a pinning layer exchange coupled to the pinned layer structure for pinning the magnetic moment of the pinned layer structure;

forming a nonmagnetic conductive spacer layer between the free layer structure and the pinned layer structure;

a making the free layer structure including the steps of:

obliquely ion beam sputtering first and second cobalt or cobalt based layers and a nickel iron based layer in the presence of a magnetic field oriented in a direction of said easy axis with the first and second cobalt or cobalt based layers interfacing the spacer layer and a cap layer respectively and the nickel iron based layer being located between and interfacing the first and second cobalt or cobalt based layers; [and]

the oblique ion beam sputtering being at angles $\alpha = 40°$ and $\beta = 10° - 30°$ wherein angles α and β are orthogonal; and

after said oblique ion beam sputtering in the presence of said field oriented in said direction on the easy axis, annealing each of the cobalt or cobalt based layers and the nickel iron based layer.

46. (Once Amended) A method as claimed in claim 44 wherein the step of oblique ion beam sputtering includes the steps of:

providing a sputtering chamber;

providing a nonmagnetic conductive target in the sputtering chamber that has a nominal planar surface;

positioning a substrate in the chamber that has a nominal planar surface at an angle to the nominal planar surface of the target;

providing an ion beam gun in the chamber for bombarding the target with ions which causes ions of the material to be sputtered from the target and deposited on the substrate to form said cobalt or cobalt based layers[.]<u>; and</u>

<u>the sputtering being at angles $\alpha = 40°$ and $\beta = 10° - 30°$ wherein angles α and β are orthogonal and are angles between the nominal surface planes of the target and the substrate.</u>

48. (Twice Amended) A method of making magnetic head assembly that includes a write head and a read head, comprising the steps of:

a making of the write head including:

forming ferromagnetic first and second pole piece layers in pole tip, yoke and back gap regions wherein the yoke region is located between the pole tip and back gap regions;

forming a nonmagnetic nonconductive write gap layer between the first and second pole piece layers in the pole tip region;

forming an insulation stack with at least one coil layer embedded therein between the first and second pole piece layers in the yoke region; and

connecting the first and pole piece layers at said back gap region; and

making the read head as follows:

forming a spin valve sensor and first and second nonmagnetic first and second read gap layers with the spin valve sensor located between the first and second read gap layers;

forming a ferromagnetic first shield layer; and

forming the first and second read gap layers between the first shield layer and the first pole piece layer; and

a making of the spin valve sensor comprising the steps of:

forming a free layer structure that has a magnetic moment and an easy axis;

forming a ferromagnetic pinned layer structure that has a magnetic moment;

forming a pinning layer exchange coupled to the pinned layer structure for pinning the magnetic moment of the pinned layer structure;

forming a nonmagnetic conductive spacer layer between the free layer structure and the pinned layer structure;

a making of the free layer structure including the step of:

obliquely ion beam sputtering first and second cobalt or cobalt based layers and a nickel iron based layer in the presence of a magnetic field oriented in a direction of said easy axis with the first and second cobalt or cobalt based layers interfacing the spacer layer structure and a gap layer respectively and the nickel iron based layer being located between and interfacing the first and second cobalt or cobalt based layers; [and]

<u>the oblique ion beam sputtering being at angles $\alpha = 40°$ and $\beta = 10° - 30°$ wherein angles α and β are orthogonal; and</u>

after said oblique ion beam sputtering in the presence of said field oriented in said direction of the easy axis, annealing each of the cobalt or cobalt based layers and the nickel iron based layer.

63. (Once Amended) A method as claimed in claim 55 wherein the electrical device is a magnetic head assembly and further comprises the steps of:

said at least one [magnetic] <u>material</u> layer being a ferromagnetic free layer;

a ferromagnetic pinned layer;

a nonmagnetic spacer layer located between the free and pinned layers; and

the pinned and spacer layers being ion beam sputtered at an angle α which is acute and at an angle β which is zero.